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THE EUROPEAN CORN BORER IN PENNSYLVANIA

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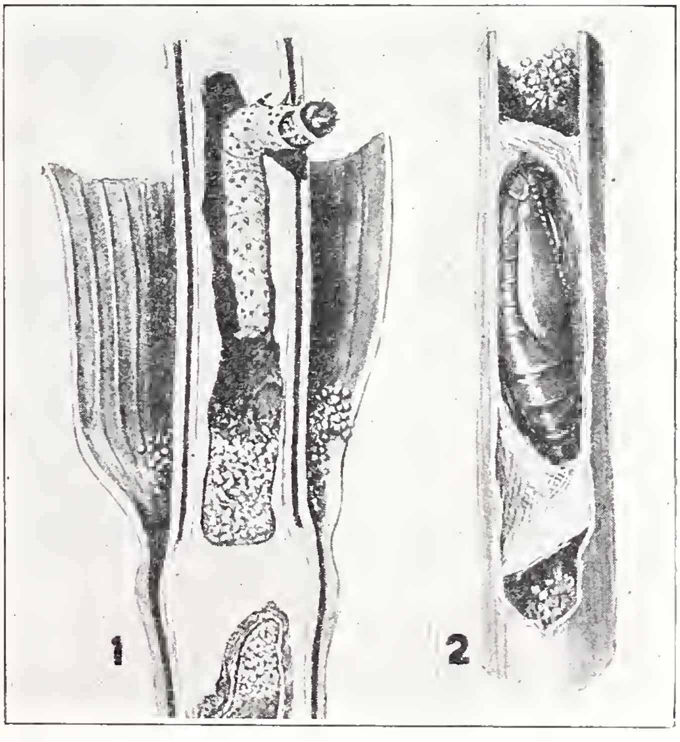

FIG. 1.—CORN STALK SECTIONED, SHOWING LARVA OF EUROPEAN CORN BORER IN BURROW.
FIG. 2.—EUROPEAN CORN BORER PUPA IN ITS CHAMBER.

F. P. Willits, Secretary of Agriculture

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FIGHTING THE EUROPEAN CORN BORER

The European corn borer was first found in Pennsylvania in 1919. By the end of the 1924 season it had spread over an area of 1,999 square miles in Erie, Crawford, Mercer and Warren counties.

The control of this insect is a problem of the community as well as of the individual. The use of poisons, such as sprays, arsenate of lead and other materials, directed against the adult moths is of no practical value and, therefore, reliance must be placed on such improved cultural practices as will destroy the larvae or worms which winter over in the stalks, cobs or stubble of the corn plant. The following suggestions on control are recommended:

Cut corn close to the ground and as early as possible.

Cut and remove sweet corn fodder from the fields as soon as the ears are harvested. Feed direct to livestock, or place in silo.

Cut and remove field corn fodder as soon as the ears are mature. Feed the stalks to livestock as soon as possible, and destroy the uneaten parts before May first following. Shredding or cutting the fodder will render it more easily consumed by livestock and more certainly insure destruction of any larvae in the stalks.

Burn or otherwise destroy before May first of each year all old corn stalks, corncobs, corn stubble and other crop remnants found in infected fields.

Burn dry corncobs and corn stalks found in hog pens, feed lots and around feed troughs of barn.

Plow under thoroughly to a depth of at least six inches in November, all infested corn stalks, corn stubble or other waste material which it is impracticable to destroy by methods previously mentioned.

Earliest planted sweet corn is most likely to become infested, whereas later plantings usually are injured to a lesser extent.

Help prevent spread of this insect by not transporting corn on cob or corn stalks outside the quarantined area. This will avoid confiscation at the quarantine lines since the present quarantine prohibits the movement of such articles except after proper inspection.

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By C. H. Hadley,

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INTRODUCTORY

The experience of the 1924 season in the counties of Erie, Crawford, and Mercer in northwestern Pennsylvania has shown clearly that the European corn borer is another imported pest which must be reckoned with in the development of Pennsylvania agriculture. While at the present time the insect has not assumed the importance economically which it has in Canada, Ohio and New England, conditions obtaining in the infested territory of the state indicate beyond any reasonable doubt that the pest will quite probably become one of the most, if not the most, dangerous insect enemies of corn, and perhaps of other field and ornamental crops as well.

This circular has been prepared in response to the general demand for information on the subject, and is based upon our present knowledge of the situation.

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[1] *Pyrausta nubilalis* Hubn.: order Lepidoptera, family Pyralidae, subfamily Pyraustinae.

Note: The European corn borer control work in Pennsylvania is being conducted by the State Department of Agriculture in full cooperation with the extension service of the Pennsylvania State College and the Bureau of Entomology, United States Department of Agriculture. Cover page illustration and Plate I are from United States Department of Agriculture Farmers' Bulletin 1046; all other illustrations are original.

SPREAD IN PENNSYLVANIA

The European corn borer was first found in Pennsylvania at Girard, Erie County, in the early fall of 1919. The infestation was slight, and is thought to have had its origin in infested plant material drifting in the waters of Lake Erie; it is possible also that the forced flight of moths from the early Ontario infestation may have resulted in the Girard infestation.

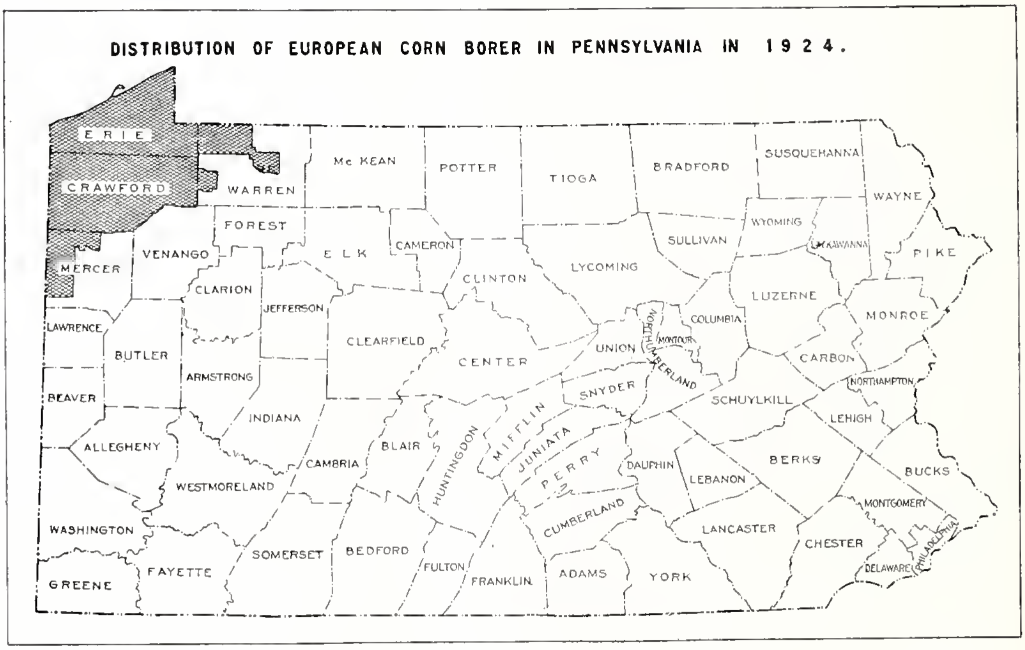

Fig. 3. Map showing distribution of the European corn borer in Pennsylvania at the end of the 1924 season.

For the first few years following this finding, the insect spread comparatively slowly, and its numerical increase was distinctly small. The relative yearly spread is shown by the following tabulation:[1]

1919— 32 square miles in Erie County.
1920— 32 square miles in Erie County.
1921— 302 square miles in Erie County.
1922— 613 square miles in Erie, Crawford Counties.
1923— 653 square miles in Erie, Crawford Counties.
1924—1999 square miles in Erie, Crawford, Mercer, Warren Counties.

During the 1924 season, European corn borer larvae were found in every township in Erie and Crawford counties, the townships of Green, Hickory, Salem, Sugar Grove and West Salem, in Mercer County, and the townships of Columbus, Conewango, Eldred, Freehold and Sugar Grove, in Warren County. (See map on pg.—)

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[1] These figures have been furnished by the Bureau of Entomology of the United States Department of Agriculture.

DISTRIBUTION IN NORTH AMERICA

At the present time the European corn borer is known to be present in three separate areas in North America. The New England area includes portions of Maine, New Hampshire, and Massachusetts. The most severe and general damage is being caused in this area.

The eastern New York area is the smallest area and centers around Schenectady, N. Y. The Great Lakes infestation comprises portions, bordering on the lakes, of the Province of Ontario (Canada) and the states of New York, Pennsylvania, Ohio and Michigan. This is the largest of the general areas of infestation, and considerable economic loss is being sustained especially in Ontario and Ohio.

MANNER OF SPREADING

It is believed that the insect was originally brought into this country in infested broom corn imported in 1909 and 1910 from Hungary and Italy. Broom corn is quite generally infested by this insect in Europe.

The insect may be spread locally through the powers of flight of the adult moths, which are capable of making flights of several hundred yards at a time, usually with the wind. Caffrey and Worthley[1] state that "marked moths of both sexes have been recovered at distances of from five to nearly twenty miles from the point of liberation."

The insect may be distributed artificially in a number of ways, the most important of which is through the movement (in ordinary commerce) of infested plant products, especially field and sweet corn.

The dispersion of the insect by infested floating drift in streams and lakes is a very probable and important factor in distribution, and is one which is not readily subject to control by preventive measures.

[1] The European Corn Borer and Its Control, D. J. Caffrey and L. H. Worthley, U. S. Dept. Agr., Farmers' Bulletin 1294, 1922.

SIGNS OF INFESTATION

It is not difficult in winter to determine the presence of the European corn borer in infested stalks. Characteristic holes about one-eighth of an inch in diameter usually with the margins of the hole more or less discolored, indicate infestation of the stalk, and it is

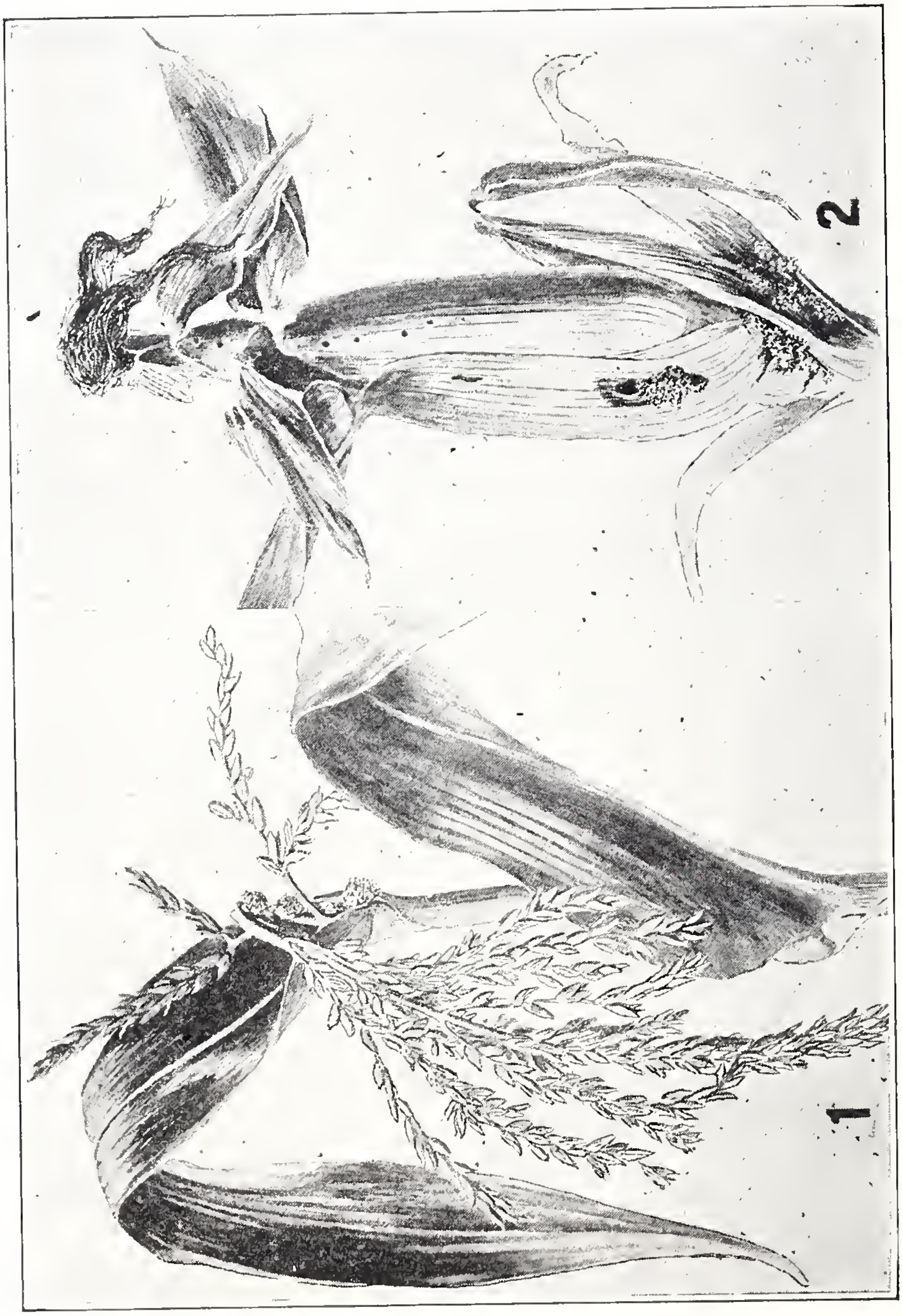

PLATE I—Fig. 1.—Tassel of infested corn broken over, a very conspicuous sign of infestation.
Fig. 2.—Infested ear of sweet corn, showing entrance and exit holes of larvae, with masses of frass adhering.

not at all uncommon for the opening of the hole to be plugged with borings. Such holes are more easily seen on stalks from which the leaves have been stripped off by cattle or through some other cause. Inside the infested stalk may be found irregular burrows or galleries (see cover page, Fig. 1) ranging from one inch to several inches in length; the yellowish gray caterpillar inhabits its burrow during the hibernating period in the winter. Such infestation is likewise very commonly found in stubble in infested fields.

During the summer season the injury is very much more conspicuous, especially in the case of green corn. The hole in the infested stalk and ear usually is marked by masses of borings hanging from the stalk, and often an exudation of sap is present as well (see Plate I, Fig. 2). The same type of hole is commonly found in the case of infested husks and stems of ears. Oftentimes the cob itself and the grains will be tunneled by the borers. One of the most readily recognized signs of infestation in fields of corn is the presence of broken tassels with masses of borings hanging at the point of the injury (see Plate I, Fig. 1). This is an almost unmistakable sign of infestation by the European corn borer, since there is no other pest which has this general habit of boring into the stalks and cobs.

FOOD PLANTS AND FEEDING HABITS

So far at least, the principal food plants of the European corn borer in Pennsylvania are sweet and field corn, both flint and dent varieties of the latter being attacked. To a very much less extent the infestation is occasionally found in celery, in certain ornamental plants such as dahlias, and in a few of the commoner weeds. In New England, however, the insect has a much wider range of food plants, including in addition to sweet, field and fodder corn, a great variety of other plants, especially vegetables and ornamental flowering plants. A large number of weeds and wild grasses are likewise infested by the insect. It is quite probable that the insect will feed on a wider range of plants under Pennsylvania conditions, as it becomes better established.

The borers have very peculiar feeding habits. On hatching from the eggs (which are laid on the undersides of the leaves) the larvae frequently feed for a short time upon the leaves, and then work their way along the leaf to the main stem and bore into the stem itself, or perhaps on the unfolded tassel of the corn plant. They grow quite rapidly, and their presence in the stem is very conspicuously indicated by the breaking over of the tassel, resulting from the tunnels eaten into it by the borer. The broken tassel soon wilts, becomes bleached and whitened, and stands out very conspicuously among the uninfested healthy tassels. The larvae frequently tunned down the stem of the leaf, and enter new places either lower down in the stem, or even in the ear. In a badly infested field, the stem of the corn plant may become absolutely riddled with tunnels and entrance openings, resulting in the drooping of the leaves and the breaking over of the plant in one or more places, with the final result in the death of the plant.

During the latter part of the summer season quite frequently the eggs are deposited directly upon the newly developed ears of late corn, and the borers after first feeding upon the silk will then enter the ears directly, where they feed upon the cob and grain. This type of injury, if at all extensive, results in the complete destruction of the ear. Quite frequently also a rot follows the work of the borers, resulting in still further loss of stalks and ears.

LIFE HISTORY

This insect passes the winter as a full grown larva within the stalk or ear of corn or other host plants. With the warm weather of April or May, the borer becomes active and cuts a small opening from its tunnel to the surface of the plant as an outlet for the moth. It then covers this hole with a thin silk-like substance and proceeds to spin a cocoon within its tunnel, changing to the pupa or resting stage inside this cocoon. It remains in the pupa form for about fourteen days, when it emerges as a moth. This occurs in Pennsylvania about the fourth week of June. The moths remain during the day, hiding in weeds, grass or other plants, and fly in the early evening and early morning, depositing eggs in small masses usually on the under side of the leaf or on the stalk of the host plant. A single female will lay from 350 to over 1000 eggs, and the life of the moths of both sexes is about fifteen days.

The eggs hatch in from four to six days with an average of about five days, and the newly hatched borer is about one-sixteenth of an inch long with a black head and a pale yellow body bearing several rows of small black or brown spots. It feeds a few days on the surface, but soon enters the plant and completes its development therein, although it may migrate to other plants. The borer continues to feed until cold weather, remaining in its tunnel during the winter.

DESCRIPTION OF STAGES OF THE INSECT

The moths are about three-quarters of an inch long with a slender body and a wing expanse of from one to one and one-quarter inch. In color the females are rather cream colored with more or less of a brownish tint, and with three narrow wavy purplish brown bands across the wings, the males are somewhat smaller than the females and are darker in color, pale brown more or less blotched and banded with creamy yellow (See Plate II).

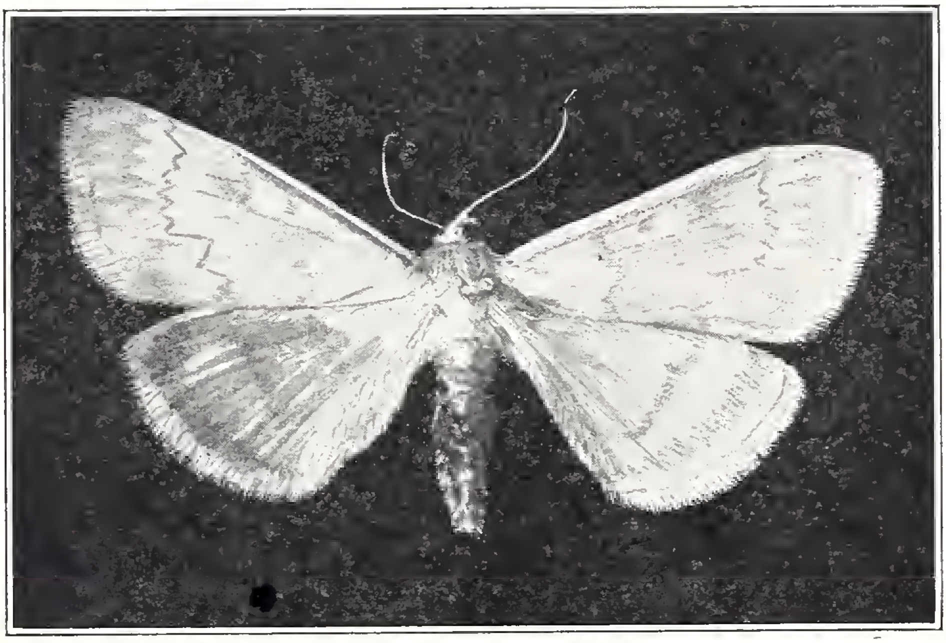

PLATE II—Adult (female) moth of European corn borer, enlarged.

The eggs are laid in small irregular clusters of from three to forty each, usually laid on the underside of corn leaves at about the point where the leaf bends over. The eggs themselves are circular in shape, flat, glistering white, and overlap each other more or less like fish scales. As they mature the eggs become yellowish, and shortly before hatching the black heads of the little borers inside may be seen quite easily. When first hatched, the larvae are very small, being about one-sixteenth of an inch in length. They are, however, voracious feeders and grow very rapidly, becoming about an inch in length when mature, smooth, pale brownish white or dirty white, with occasionally a pinkish tint; the head is dark brown, and the body is spotted with numerous small brown dots (See cover page, Fig. 2 and Plate III, Fig. 3).

The pupa or resting stage of the insect is cigar-shaped, about three-quarters of an inch long, and varies in color from pale yellowish brown to dark reddish brown (See cover page, Fig. 2).

CATERPILLARS LIKELY TO BE MISTAKEN FOR THE EUROPEAN CORN BORER

Among the caterpillars more or less commonly found in Pennsylvania under conditions similar to those where the European corn borer may be found, are several which may easily be mistaken for the European corn borer.

One of the commonest species apt to be mistaken is the larvæ of the corn ear worm, *Heliothis obsoleta* Fab. (See Plate III, Fig. 1). The corn ear worm is about an inch and one-quarter or thereabouts in length, and varies in color from light green to dark brown with more or less indistinct stripes on the back, and a quite conspicuous pale colored band along the side; the head is yellowish brown in color. This caterpillar is a fairly common pest of corn, usually feeding on the kernels in the ear and eating into the cob.

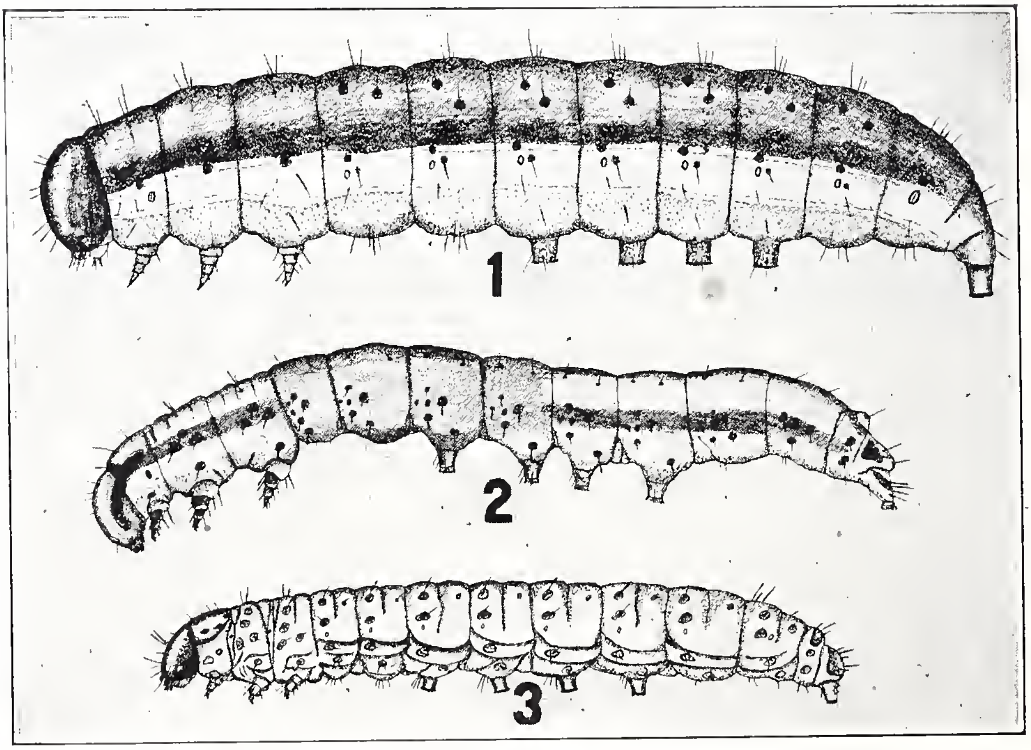

PLATE III—European corn borer and larvae closely resembling it.
Fig. 1.—Corn earworm. (*Heliothis obsoleta* Fab.):
Fig. 2.—Stalk borer. (*Papaipema nitela* Guen.):
Fig. 3.—European corn borer. (*Pyrausta nubilalis* Habner.)

Perhaps the other species of caterpillar most apt to be mistaken for the European borer is the stalk borer, *Papaipema nitela* Gn. (See Plate III, Fig. 2). This is a very common borer, especially in certain seasons, and may cause at times considerable injury in corn fields. The stalk borer is also a rather common pest of potatoes and tomatoes and certain weeds. It is not difficult to distinguish the caterpillar of the stalk borer from that of the European corn borer, as the caterpillars of the stalk borer have a conspicuous dark brown or purple band around the middle of the body and several conspicuous brown or purple stripes running lengthwise on the body. The larvæ of the stalk borer habitually works within the growing tip or heart and stalk of young corn, but is never found in corn stalks during the winter.

The smart weed borer, *Pyrausta ainsliei* Heinrich, is frequently found in corn during the autumn, winter and spring, and in its work resembles that of the European corn borer so closely that it is often difficult to distinguish between them. The smart weed borer usually feeds within the stems of smart weeds, but quite commonly bores into the stalks of corn and other plants for winter quarters. The caterpillars are when mature about three-qaurters of an inch long, slate colored or gray, and have a very fine faint line of dark color running along the middle of the back, this line being very much narrower and less conspicuous than in the case of the European corn borer.

FUTURE OF THE CORN BORER IN PENNSYLVANIA

It is difficult to predict exactly the development of the European corn borer in Pennsylvania. The spread and numerical increase of the insect during the first five years of its existence in northwestern Pennsylvania was very limited. The extensive spread and numerical increase of the insect during the 1924 season, however, is indicative of the fact that the insect finds conditions in the northwestern part of the state quite favorable for its rapid development.

The range of food plants at the present time is very limited, but, on the other hand, the conditions obtaining in the New England infestation and in the Canadian infestation make it appear quite probable that the present known range of food plants will be very materially increased as the infestation becomes greater.

Up to the present, there has been no widespread damage in the Pennsylvania infestation, although during the season of 1924 infestation in parts of Erie and Crawford Counties was quite severe; in Erie County especially, fields of sweet corn were in some cases quite heavily infested, and quite a fair proportion of the ears were rendered practically worthless. There seems to be little doubt, however, that the damage may become quite severe after a succession of several favorable seasons for the insect, wherein the numbers of the insect become very materially increased.

In Canada, Ohio, and the New England districts the European corn borer has reached a stage where it is a pest of first importance, especially to the corn crop. In New England especially it has become a pest of major importance to certain vegetable and flowering crops. It seems entirely within the rank of possibility, therefore, that the insect may become a major pest of these crops in northwestern Pennsylvania. Certainly there is no indication that this insect is a pest to be neglected.

The infestation at present in Pennsylvania is fairly remote from the major corn growing counties of the state. Should the insect become established in the corn growing district of the state, especially through the southeastern and central southern counties, there is little doubt but that it would shortly become a pest of vast importance. The corn crop is a major crop, and so far as can be told now, conditions through these corn-producing districts would be very favorable for the development of the insect. For this reason, therefore there is also every reason for taking vigorous steps to control this insect.

FEDERAL AND STATE QUARANTINES

As an important part of its efforts to hold down the distribution of this insect in the United States, the Federal Government has quarantined the states in which infestations exist. The Federal quarantine applies specifically to the localities in any state in which infestation actually occurs, where such Federal quarantine is supplemented by a state quarantine.

The Pennsylvania Department of Agriculture has promulgated quarantine orders supplementing the Federal quarantine, providing for inspection and certification of corn and other plants. The quarantine regulations prohibit the movement of corn on cob, corn stalks and other quarantined articles to points outside of the quarantined area, except after inspection and certification by a duly authorized inspector. For the present season, the areas to which these quarantines apply in Pennsylvania are as follows:

In Erie and Crawford Counties—all townships.

In Mercer County—the townships of Green, Hickory, Pymatuning, Salem, South Pymatuning, Sugar Grove, and West Salem.

In Warren County—the townships of Columbus, Conewago, Eldred, Freehold, and Sugar Grove.